The opinion in support of the decision being entered today is *not* binding precedent of the Board.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte HIROSHI NEMOTO and KENSHIN KITOH

Appeal 2007-3662
Application 09/997,604
Technology Center 1700

Decided: August 27, 2007

Before CHARLES F. WARREN, PETER F. KRATZ, and CATHERINE Q. TIMM, *Administrative Patent Judges*.

TIMM, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants appeal under 35 U.S.C. § 134(a) from the Examiner's decision rejecting claims 11-14, 16-21, 23, and 24. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

I. BACKGROUND

The invention relates to the production of lithium secondary batteries. Claim 17 is illustrative of the subject matter on appeal:

17. A method of making a lithium secondary battery having low internal resistance, comprising:

welding a plurality of current collecting portions directly to a positive electrode, said positive electrode comprising a positive electrode active material formed by a process comprising:

> forming a raw material mixture comprising positive electrode precursor material, said raw material mixture comprising Li and Mn; and
>
> heating said raw material mixture to a temperature and for a time which is effective to convert said raw material mixture into a positive electrode active material having a cubic spinel structure, primary particles of the positive electrode active material having a substantially octahedral shape constituted mainly by flat crystal faces, said primary particles including particles having at least one side of each flat crystal face of length of 1 μm or more;

said battery having a capacity of 2 Ah or more.

The Examiner relies on the following prior art references to show unpatentability:

Okada[1]	JP 08-217452	Aug. 27, 1996
Zhong	US 5,700,597	Dec. 23, 1997
Watanabe	US 6,106,975	Aug. 22, 2000
Zhong	US 5,631,104	May 20, 1997
Manev	US 5,961,949	Oct. 5, 1999

[1] With regard to Okada, we have considered both the machine translation and the translation provided by Schreiber Translations, Inc. We cite to the Schreiber translation in the following discussion.

Idota US 5,686,203 Nov. 11, 1997

The Examiner maintains the following rejections:[2]

1. Claims 11-14, 16-21, and 23 under 35 U.S.C. § 103(a) as unpatentable over:
    a. Okada in view of Zhong '597 and Watanabe;
    b. Zhong '104 in view of Zhong '597 and Watanabe; and
    c. Manev in view of Zhong '597 and Watanabe.
2. Claim 24 under 35 U.S.C. § 103(a) over the prior art of rejections 1b and 1c above, each further in view of Idota.
3. Claims 11-14, 16-21, 23, and 24 under 35 U.S.C. § 112, ¶ 1 as lacking enablement for the full scope of the claims.

II. DISCUSSION

Obviousness

With regard to all the obviousness rejections, the main issue on appeal arising from the contentions of Appellants and the Examiner is: Do any one of Okada, Zhong '104, or Manev teach or suggest primary particles "having a substantially octahedral shape" and "including particles having at least one side of each flat crystal face of length of 1 μm or more?"

For the reasons that follow, we answer in the affirmative.

With regard to the question at hand, Appellants do not argue any claim apart from the others. We select claim 17 to represent the claims on appeal in deciding the issue. Claim 17 requires heating to form "positive

[2] The Examiner has withdrawn a rejection of claims 12 and 19 under 35 U.S.C. § 112, ¶ 1 (Answer 2).

electrode active material having a cubic spinel structure, primary particles of the positive electrode active material having a *substantially* octahedral shape constituted mainly by flat crystal faces." (Emphasis added.) While we have considered each rejection individually, as the issue is the same in each, we discuss them together.

We consider first the scope of the language of the claims. We do so with the understanding that during examination, "claims . . . are to be given their broadest reasonable interpretation consistent with the specification, and . . . claim language should be read in light of the specification as it would be interpreted by one of ordinary skill in the art." *In re Am. Acad. of Sci. Tech. Ctr.*, 367 F.3d 1359, 1364, 70 USPQ2d 1827, 1830 (Fed. Cir. 2004).

According to the Specification:

> In the positive electrode active material having such a composition [, i.e., lithium manganese oxide composed mainly of Li and Mn,] and a cubic spinel structure, the primary particles mostly have a substantially octahedral shape constituted mainly by flat crystal faces, as seen in Fig. 1 which is a SEM photograph showing a morphology of such primary particles. That is, flat crystal faces intersect with each other at the surface of each primary particle to form clear edge lines, and each primary particle has a shape close to the octahedron of cubic spinel structure.
>
> The primary particles seen in Fig. 1 also include particles of other shapes, that is, (a) particles wherein the apex formed by intersection of four crystal faces of octahedron is not complete and is formed in the form of a plane or an edge, (b) particles wherein a different crystal face is formed at the edge formed by intersection of two crystal faces of octahedron, and (c) particles wherein one crystal face is jointly owned by two primary particles or wherein other primary particle grows from the surface of one primary particle. These primary particles do not have a completely octahedral shape but can be regarded as a substantially octahedral shape. *In the present invention, the*

> *"substantially octahedral shape" include these various shapes and further include those polyhedrons formed by partial chipping of the above shapes or by joint possession of crystal face in complicated manner between two primary particles.*
>
> The positive electrode active material used in the present lithium secondary battery is characterized by consisting of primary particles mostly having the above-mentioned morphology. Thus, all the primary particles need not have a substantially octahedral shape.

(Specification 7:24 to 8:24).

As the Specification makes clear, Appellants intend "substantially octahedral shape" to include crystal shapes that have some aspect of octahedral configuration but are not completely octahedral in nature. For instance, even if a crystal has a different crystal face where two faces of an octahedron would normally form an edge, or if a crystal is a complicated polyhedron based on the growth of one primary particle from the surface of another, it will still be "substantially octahedral" as that terminology is used in the claims.

Turning to the phrase "said primary particles including particles having at least one side of each flat crystal face of length of 1 μm or more," we note the word "including" in the phrase. Any primary particles including even a small amount of particles big enough to meet the 1 μm or more face size, will meet the requirements of claim 17.

Turning to the prior art and considering what it teaches in comparison to what is encompassed by claim 17, we determine that the references applied by the Examiner teach or suggest heating to form primary particles of crystallinity and size within the claimed ranges.

Okada, Zhong '104, and Manev are, like Appellants, directed to forming positive electrode active material from lithium manganese oxides and metal substituted lithium manganese oxides. Each reference discloses that the compounds have a spinel or spinel-like crystal structure (Okada ¶ 0036; Zhong '104, col. 5, ll. 12-23; Manev, col. 1, ll. 16-19). Appellants' Specification and Okada reflect the understood meaning of "spinel" as a class of minerals that form octahedral crystals.[3] (Specification 7:24 to 8:6 "shape close to the octahedron of cubic spinel structure"; Okada, ¶ 0036 describing the spinel structure in terms of its octahedral packing structure.)

Appellants contend that Okada is directed to particles of needle-like (acicular) shape. But the only reference to such a shape is in paragraph 0107 of Okada. Paragraph 0107 is directed to a comparative example and states that what was obtained in that example was a compound "of acicular regular octahedron particles with a one side length of 1 μm or greater." It is "comparative" because its BET specific surface was outside the desired range.

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[3] *See McGraw-Hill Dictionary of Scientific and Technical Terms* (5th ed. 1994) defining "spinel" as "1. $MgAl_2O_4$ A colorless, purplish-red, greenish, yellow, or black mineral, usually forming octahedral crystals, and characterized by great hardness; used as a gemstone. 2. A group of minerals of general formula AB_2O_4, where A is magnesium, ferrous iron, zinc, or manganese, or a combination of them, and B is aluminum, ferric iron, or chromium." *See also Dictionary.com* (v 1.1): "1. any of a group of minerals composed principally of oxides of magnesium, aluminum, iron, manganese, chromium, etc., characterized by their hardness and octahedral crystals. 2. a mineral of this group, essentially magnesium aluminate, $MgAl_2O_4$, some varieties being used as gems."

We cannot agree that Okada is only teaching the formation of acicular regular octahedron particles. That language is not used to describe any of the other exemplified compounds.

Nor can we agree that Appellants' claims exclude particles of "acicular regular octahedron" shape. Figure 4 of Okada shows the primary particles of comparative example 1, and that figure shows particles of "substantially octahedral shape" within the meaning of the claims. While some of the particles, as argued by Appellants, include flat faces where edges would arise in an ideal octahedron, as discussed above, the claim language "substantially octahedral shape" allows for such deviations in shape (Specification 8:10-12). The "substantially" language also encompasses polyhedrons based on the growth of one primary particle from the surface of another primary particle, shapes also seen in Figure 4 (see also Appellants' Appendices E and F).

With regard to the length of the crystal face, Okada describes the particles of comparative example 1 as having faces of the claimed length (Okada ¶ 0107). Moreover, given the diameters of the particles of the other examples (10 μm or smaller (Exs. 4 and 5); 5 μm or smaller (Exs. 1-3)), they too would have at least some faces of 1 μm or more. For an octahedral polygon, the length of a face has to be more than half the diameter of the particles. Moreover, as we explained above, to meet the claim only a small amount of the faces need meet the 1 μm or more length limitation.

Furthermore, Manev provides evidence that optimizing the particle size and thus the face length through routine experimentation would have also been obvious to one of ordinary skill in the art. Manev explains that the mean particle size and the particle size distribution directly influence the

properties of the positive electrode of the secondary lithium batteries (Manev, col. 1, ll. 40-47). Manev discusses the properties affected by the mean particle size (Manev, col. 1, ll. 43 to col. 2, l. 10), and provides guidance as to how to obtain desired particle size by selecting appropriate heating temperatures, heating duration, and the size of manganese compound starting particles (Manev, col. 4, l. 30 to col. 5, l. 33). Manev discloses that a mean particle size of 10-15 μm provides good properties (Manev, col. 5, ll. 24-33). Particles of such size necessarily have faces with lengths of 1 μm or more.

Okada, Zhong '104, and Manev each describe how to obtain spinel crystals by heating, in one or two stages, a mixture of salts and oxides of Li, Mn, and any other metal to be included in an oxidizing atmosphere (Okada ¶¶ 0075 and 78 (heat to 500°C or lower then heat to 500-850°C, for, preferably, 10 or more hours); Zhong '104, col. 6, ll. 3-6 (750-950°C one or more times); Manev, col. 4, ll. 30-54 (400-600°C for at least 12 hours then 700-900°C for at least 10 hours). The temperatures and times of the prior art are in substantially the same range as Appellants' temperatures and times (Specification 11:5-10 (700-900°C for 5-50 hours)). But most importantly, all the references perform the heating step specifically to obtain a spinel structure, i.e., crystals of octahedral shape. One of ordinary skill in the art would have conducted the process in order to get the desired crystals.

We also agree with the Examiner that it is reasonable to conclude that the primary particles formed in the Inventive Example 3 of Zhong '104 (col. 9, ll. 32-37) would have particles with face lengths of 1 μm or more as claimed. While Appellants contend that not all temperatures and times will result in the claimed morphology (Br. 14-15), Inventive Example 3 of Zhong

'104 describes a very specific heating regime for a specific composition. Zhong '104 further specifically desires to obtain spinel crystalline structure and optimizes the particles for use in lithium batteries. Based on the similarities of the composition and heating regime as well as the crystalline structure, it is reasonable to shift the burden to Appellants to show that there is, in fact, a difference between the particles of Example 3 of Zhong '104 and those claimed. Appellants have not presented convincing evidence of a patentable difference.

We determine that each one of Okada, Zhong '104, and Manev teach or suggest primary particles "having a substantially octahedral shape" and "including particles having at least one side of each flat crystal face of length of 1 μm or more" as required by the claims.

With regard to the combination of Okada, Zhong '104, and Manev, respectively with Zhong '597 and Watanabe, Appellants make generalized statements about differences between what the references teach and what is claimed (Br. 16-17, Br. 20-21, Br. 23-24), but Appellants do not identify any specific reversible error in the Examiner's rejections. There is, therefore, no further issue in this regard for us to consider.

With respect to the rejection of claim 24, Appellants present no further arguments specific to the limitation for which Idota was added as evidence of obviousness. Again, there is no further issue for us to consider.

Enablement

Given the level of guidance in the Specification and in the prior art concerning how to obtain primary particles of spinel crystallinity, i.e., crystals of substantially octahedral shape, and how to control particle size, we cannot agree with the Examiner that Appellants need limit their claims to

the metal substituted lithium manganese oxide Appellants exemplify in the Specification. The evidence tends to show that no more than routine experimentation was required of one of ordinary skill in the art of lithium secondary battery production, and the Examiner has not sufficiently rebutted that evidence.

III. CONCLUSION

We sustain the rejection of claims 11-14, 16-21, 23, and 24 under 35 U.S.C. § 103(a), but we do not sustain the rejection of claims 11-14, 16-21, 23, and 24 under 35 U.S.C. § 112, ¶ 1.

IV. DECISION

The decision of the Examiner is affirmed.

V. TIME PERIOD FOR RESPONSE

No time period for taking any subsequent action in connection with this appeal maybe extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED

Appeal 2007- 3662
Application 09/997,604

tc/ls

BURR & BROWN
P.O. BOX 7068
SYRACUSE, NY 13261-7068